Willingness to Pay for Agricultural Environmental Safety: Evidence from a Survey of Milan, Italy Residents

Travisi, C.M.; Nijkamp, P.

2004

TI 2004-070/3
Tinbergen Institute Discussion Paper

Willingness to pay for Agricultural Environmental Safety

Chiara M. Travisi[1]
Peter Nijkamp[2]

[1] Department of Management Economics and Industrial Engineering, Polytechnic of Milan, and Fondazione Eni Enrico Mattei (FEEM), Milan, Italy,
[2] Department of Spatial Economics, Faculty of Economics and Business Administration, Vrije Universiteit, and Tinbergen Institute, the Netherlands.

Tinbergen Institute
The Tinbergen Institute is the institute for economic research of the Erasmus Universiteit Rotterdam, Universiteit van Amsterdam, and Vrije Universiteit Amsterdam.

Tinbergen Institute Amsterdam
Roetersstraat 31
1018 WB Amsterdam
The Netherlands
Tel.: +31(0)20 551 3500
Fax: +31(0)20 551 3555

Tinbergen Institute Rotterdam
Burg. Oudlaan 50
3062 PA Rotterdam
The Netherlands
Tel.: +31(0)10 408 8900
Fax: +31(0)10 408 9031

Please send questions and/or remarks of non-scientific nature to driessen@tinbergen.nl.
Most TI discussion papers can be downloaded at http://www.tinbergen.nl.

WILLINGNESS TO PAY FOR AGRICULTURAL ENVIRONMENTAL SAFETY: EVIDENCE FROM A SURVEY OF MILAN, ITALY, RESIDENTS

Chiara M. Travisi[ξ]

Department of Management Economics and Industrial Engineering, Polytechnic of Milan, Italy, and Fondazione Eni Enrico Mattei (FEEM), Milan, Italy

Peter Nijkamp

Department of Spatial Economics, Free University, and Tinbergen Institute, Amsterdam, The Netherlands

Abstract

The widespread use of pesticides in agriculture provides a particularly complex pattern of multidimensional negative side-effects, ranging from food safety related effects to the deterioration of farmland ecosystems. The assessment of the economic implications of such negative processes is fraught with many uncertainties. This paper presents results of an empirical study recently conducted in the North of Italy aimed at estimating the value of reducing the multiple impacts of pesticide use. A statistical technique known as *conjoint choice experiment* is used here in combination with *contingent valuation* techniques. The experimental design of choice modelling provides a natural tool to attach a monetary value to negative environmental effects associated with agrochemicals use. In particular, the paper addresses the reduction of farmland biodiversity, groundwater contamination and human intoxication. The resulting estimates show that, on average, respondents are prone to accept substantial willingness to pay premia for agricultural goods (in particular, foodstuff) produced in environmentally benign ways.

Keywords: pesticide risks, food safety, willingness-to-pay, choice modeling, contingent valuation
JEL codes: C42, H23, I12, Q24

[ξ]Corresponding author: **Chiara M. Travisi** Fondazione Eni Enrico Mattei, Corso Magenta 63, 20123 Milan, Italy. Phone: +39.02.52036951.Fax: +39.02.52036946. chiara.travisi@feem.it
Polytechnic of Milan, Department of Management Economics and Industrial Engineering. Via Colombo, 40 – 20133 - Milan, Italy. Phone: +39-02-23992749. Fax: +39-02-23992730. chiara.travisi@polimi.it

1. Introduction

Conventional agriculture produces non-negligible negative side-effects that have been broadly scientifically documented in the scientific literature (Pimentel et al., 1992; Pimentel and Greiner, 1997). The order of magnitude of these externalities justifies the theoretical and political significance of the literature on agro-environmental regulations, pesticide and fertiliser reduction, and the assessment of the associated economic costs. In the European Union, the increasing awareness of governments and consumers for pesticide-related food safety and the changing social preferences towards improving the environmental sustainability of agriculture have culminated in a number of valuable studies on the estimation of consumers' willingness to pay (WTP) for reducing the potential impact of pesticide use on human health and the environment (Swanson, 1998; Mourato et al., 2000; Foster and Mourato, 2000; Schou et al., 2002). Monetary estimates of individual WTP for pesticide risk reduction is a key input to design and implement appropriate pesticide policy measures (such as pesticide taxation, design of eco-labelling) or to plan national incentive programmes for the dissemination of more environmental benign agricultural practices. In this context, the Italian agricultural policy aims to decrease the risks attached to the use of pesticides by providing economic incentives for organic farming and Integrated Pest Management (IPM) [1].

The design of eco-labelling for fresh food produced with more benign agricultural practices is a major concern in the Italian agricultural sector. Economic theory suggests that an efficient incentive should be set equal to the marginal damage associated with pesticide usage. Similarly, estimates of individual WTP for pesticide risk reduction would provide key information to introduce price differentials in products, according to the type and severity of pesticide risks related to their production processes. In this perspective, a proper incentive programme for Italian farmers, or the design of eco-labelling, would require a estimating of the Italians' WTP for pesticide risk reduction. This paper presents an original study recently conducted in Italy with the aim of providing estimates of the WTP of Italian consumers to gain improvements in the environmental and health safety of agriculture.

Our study has combined two *stated preference* methods, Conjoint Choice Experiment (CCE) and Contingent Valuation (CV) techniques, to estimate the value of reducing the multiple impacts of pesticide use. Examples of previous studies using CV methods for pesticide risk valuation can be found in Higley and Wintersteen (1992); Bubzy et al. (1995); Mullen et al. (1997); Fu et al., (1999); Brethour and Weersink (2001); Cuyno et al. (2001); Wilson (2002). Recently, Foster and Mourato

(2000) and Schou et al. (2002) have applied Contingent Ranking techniques to value multiple pesticide impacts, while several examples of Conjoint Analysis -applied to the valuation of various pesticide risks for consumers- can be found in Baker and Crosbie (1993), Eom (1994) and Baker (1999).

The CCE application was designed to estimate the value of some important pesticide-related environmental attributes, using a ‘green shopping’ payment vehicle. Respondents were asked to view the various environmental impacts of pesticide use in the agricultural production as foodstuff attributes to be taken into account in the purchase decision. The environmental attributes taken into considerations here were the reduction in farmlands’ biodiversity, the contamination of soil and groundwater in the agricultural land, and the health effects of pesticides on the general public. The monetary attribute used was the monthly food expenditure through which it is possible to estimate the marginal value of the other non-market characteristics. The CV experiment then asked the respondents to report a maximum WTP for eliminating all the negative environmental impacts under consideration.

The reminder of the present paper is organised as follows. Section 2 presents the survey design. Section 3 discusses the econometric model used for the analysis. Section 4 presents and discusses our main results.

2. Preferences for Agricultural Safety: A Survey of Milan Residents

This study assesses people’s preferences for alternative scenarios of agricultural production based on lower pesticides input (e.g., low pesticide input, integrated pest management, organic), focusing on the environmental and economic effects they generate. Elicitation of the public’s preferences for, and economic valuation of, alternative agricultural scenarios, however, is complicated by two factors. First, the environmental negative side effects of pesticide use –such as pollution of soil, surface and ground water, higher mortality of sensitive animal and insect species, effects on human health, etc- are not bought and sold in regular markets. This implies that we need to apply non-market valuation techniques.

Second, low-input agricultural practices have only recently been applied in Italy and have not been monitored in their environmental and economic effects, so we resort to *stated preference* non-market valuation techniques, relying on what people say they would do under hypothetical circumstances rather than actual behaviours. We deploy a combination of two stated preference methods, Conjoint Choice Experiment (CCE) and Contingent Valuation (CV) techniques.

In a typical conjoint choice experiment study, respondents are asked to choose between two or more goods (or policy scenarios) each of which is described by a set of few attributes, one of which is usually its cost to the respondent. Attributes are varied across scenarios, and the scenarios are usually matched in such a way that the respondents have to trade off attributes. For the purpose of statistically modelling the respondent's choice in a conjoint choice experiment it is assumed that the respondent chooses the alternative that gives the highest utility. Utility is a function of the alternative's attributes and of residual income (income net of the cost of the alternative under consideration), plus a random term.

Depending on the assumption about the distribution of the error term, the resulting statistical model is either a conditional logit, a multinomial probit or a related choice model (Green, 2002). The implicit marginal prices of each attribute and the welfare changes associated with changes in the level of the attributes are easily derived. In a typical contingent valuation study, respondents are asked to choose between two scenarios, each of which is described by two attributes, an economic and a non-economic one.

2.1 SELECTION OF THE ATTRIBUTES

Since the range of the environmental impacts associated with pesticide use is potentially very wide, the selection of the relevant environmental attributes to be included in the questionnaire is a particularly delicate step. In choosing relevant attributes, we were guided by a group of Italian eco-toxicologists, which helped us identify main environmental effects of pesticides and select indicator variables describing each environmental effect. Environmental indicators are selected to describe, as accurately as possible, the main areas of well-documented environmental damage in Italy. Specifically, we focus on biodiversity, soil and groundwater (groundwater contamination is here considered intimately linked to soil contamination) and human health. By contrast, Foster and Mourato (2000) only considered human health and biodiversity. The impact on biodiversity is here quantified in terms of the number of endangered farmland bird species, while the impact on soil and groundwater is measured using the percentage of farmland areas contaminated by pesticides. The impact on human health is measured in terms of cases per year of acute intoxication, both as a result of work and domestic exposure. For each attribute we consider three different levels [5], as shown in Table 1.

When choosing the human health attribute we first reasoned that, since lay people –when asked about pesticides- are most frightened by potential risks related to pesticide residues in foodstuff (STOA, 1998), it would have been important to capture people WTP for improving food safety on such concern. Unfortunately, no epidemiological studies have been conducted in Italy to document pesticide residues risks. We felt, therefore, that valuing consumers WTP for a reduction of pesticide residues risk exposure would have required an appropriate analysis of risk perception concerning this, which was not our main research question. This is the reason why, rather than concentrating on pesticide residues effects, we preferred to focus on risks due to domestic or work pesticide exposure, which is the best documented pesticide impact for Italy.

Selecting the most appropriate economic attribute required us to analyse the literature and the results from focus groups discussions. In the pesticide risk valuation literature, simulated markets for green produce are sometimes used in hopes of minimizing the problem of hypothetical bias (Ravenswaay and Hoehn, 1991). However, the results of our pre-test showed that respondents were disturbed by a "single-green produce" perspective, and felt more comfortable with choices related to the whole shopping basket for groceries. Therefore, a "green shopping" payment vehicle was preferred and respondents were presented with several agricultural foodstuff market scenarios.

Table 1 – Attributes and levels.

ATTRIBUTE	*LEVEL-1 STATUS QUO*	*LEVEL-2*	*LEVEL-3*	*LEVEL-4*
Food expenditure [€/household month]	current (*)	+50	+100	+200
Human health [N° cases intoxication/year]	250	150	100	50
Soil and groundwater [% contaminated agricultural land]	65%	45%	25%	15%
Biodiversity [N° endangered farmland bird species]	15	9	6	3

(*)The current level of food expense is indicated by respondents before starting the CM exercise.

2.2 QUESTIONNAIRE AND SURVEY ADMINISTRATION

The questionnaire used in our experiment is comprised of three sections. The first part introduces the subject of the environmental side-effects of pesticides use in modern agriculture, *via* a costs-benefit perspective, which emphasized existing trade-offs between positive and negative externalities associated with agricultural production based on the use of synthetic inputs. The second section contains a Conjoint Choice Experiment/Contingent Valuation (CCE/CV) exercise, while the third one asks questions about the respondent socio-economic and attitudinal characteristics. The design of the CCE survey was inspired by recent literature on pesticide risk valuation, which extends the estimation of the social costs of pesticide applications in agriculture to both environmental and human well-being, modelled as different attributes of a common phenomenon (Mourato et al., 2000; Foster and Mourato, 2000; Schou et al., 2002).

Respondents are asked to view the various side-effects of pesticide usage due to conventional agricultural practices as food attributes to be taken into account in daily purchase decisions.

Alternatives are differentiated in terms of food expenditure and environmental sustainability, which describes the range of environmental externalities attached to the underlying production process.

Each respondent is presented with 4 or 5 choice sets developed using cyclic experimental design technique (Bunch et al., 1993) [6]. Each choice set requires respondents to make a choice among three alternative agricultural scenarios: the *status quo* scenario and two alternative ones (see Figure 1). The *status quo* scenario is represented by the conventional scenario of agricultural practices, priced at the household monthly food expense level (reported by respondents), for which each of the aforementioned environmental attributes is set at their current position (i.e., respectively, 250 cases of acute intoxication per year, 15 endangered bird species and 65% of farmland areas contaminated).

Characteristics	Option A Current Situation	Option B Alternative agricultural practices	Option C Alternative agricultural practices
Food expenditure €/household month	current	+ 50 €	+ 100 €
Biodiversity: N° of endangered bird species	15	10	5
Soil and groundwater: % of contaminated farm land	65%	30%	40%
Human Health: cases of intoxication per year	250	160	90

☐ I would choose option A, obtained with conventional agricultural practices

☐ I would choose option B, obtained with more environmental benign agricultural practices

☐ I would choose option C, obtained with more environmental benign agricultural practices

Figure 1: Example of choice set.

A CV question follows each CCE exercise. A dichotomous choice format is used to elicit information about the respondents' maximum WTP for eliminating all of the described negative effects of pesticide use on the environment and human health.

The questionnaire was developed by using the results from one focus group and one pre-test [2]. The focus group and the pre-test were necessary to test the appropriateness of the attributes included in the questionnaire, to select a proper payment vehicle of the WTP experiment, and to refine the initial draft questionnaire. On the basis of the results provided by the pilot study some minor modifications in the draft questionnaire were included [3]. The final survey was carried out in Milan between May and June 2003. The survey questionnaire was self-administered by respondents intercepted at three shopping malls in Milan by three interviewers. The enumerators were instructed to stop potential respondents and ask them to pick up the questionnaire, compile it and then drop it off after shopping. Overall, 484 questionnaires were distributed by three interviewers, 302 of which were returned in a completed form. The return rate was about 62 percent. Table 2 shows the survey statistics and the socio-demographics of the sample.

Table 2- Survey statistics and socio-demographics of the sample.

Variable	**Sample average or percentage**	**Milan average** (b)
Individual characterisitcs		
Age	33.9	44
Monthly Household Income in Euro (€/household)	2,098.1	2,791.3
Female	61.6	53.2
Household size	3.5	2.5
Household with one or more persons under 15	15.1	NA
Year of schooling	13.04	NA
Attitudinal characteristics		
Respondent with strong environmental attitude (a)	26.1	
Respondent very well informed on pesticide risks (a)	12.2	
Respondents debriefs		
Found some question hard to understand	8.5	
Did not find information provided enough	4.4	

Note:
(a) Based on a five point Likert scale
(b) Authors' calculation based on the Milan Municipality Abstract of Statistics, 2002

3. Modelling Consumers Preferences: the Econometric Model

3.1 THE CONJOINT CHOICE EXPERIMENT

Our analysis of the responses to the conjoint choice questions uses the random utility model (McFadden, 1986). Let *W* represent a set of alternative agricultural practices, and *T* the set of vectors of measured attributes. The choice for a consumer can be defined as a draw from a multinomial distribution with a probability:

$$\Pr(x|t, A) \qquad \forall x \in A \qquad \text{with } A \subseteq W \qquad (1)$$

where $\Pr(x|t, A)$ is the probability of selecting agricultural practice x, given the vector of observed attributes *t* and the set of agricultural practices *A*, for each alternative contained in the choice set *A*.

The behavioural basis of stated choice data emerges from Random Utility Model (RUM). Let U_{iq} be the utility of the ith agricultural scenario for the qth consumer. Under the RUM framework, U_{iq} is assumed to be partioned into two components: a systematic component V_{iq} that depends on the attributes, and a random component, ε_{iq} (see (2)), that is individual-specific (Ben-Akiva and Lerman, 1997).

$$U_{iq} = V_{iq} + \varepsilon_{iq} \qquad (2)$$

The utility function V_{iq}, which represents the utility of the different options in the multinomial logit model, can have different functional forms. The simplest form assumes that V_{iq} has an additive structure and is homogeneous across the population in terms of the relative importance of the attribute (x_k). The additive structure only includes the k attributes from the choice set i, as follows:

$$V_{iq} = \sum_{k=1}^{K} \beta_{kiq} x_k \qquad (3)$$

The utility V_{iq} of the ith alterative for the qth respondent consists of the sum of the values of the different attributes k. In addition, utility maximisation theory assumes that consumers will choose the agricultural scenario that yields the highest utility. Then, the individual consumer q will choose the ith agricultural scenario if and only if:

$$U_{iq} > U_{jq} \qquad \forall \mathrm{i,j} \in A \text{ with } i \neq j \qquad (4)$$

where U_{iq} is the utility level of all non-selected alternatives, and A is the set of possible choice alternatives.

Under the assumption that the error terms are independently and identically distributed and follow the Gumbel distribution, a multinomial logit model results.

Combining (3) and (4), we know that an agricultural scenario i is chosen if and only if:

$$(V_{iq} + \varepsilon_{iq}) > (V_{jq} + \varepsilon_{jq}) \text{ or } (V_{iq} - V_{jq}) > (\varepsilon_{jq} - \varepsilon_{iq}) \qquad (5)$$

Since $(\varepsilon_{jq} - \varepsilon_{iq})$ cannot be observed, it is not possible to assess exactly whether $(V_{iq} - V_{jq}) > (\varepsilon_{jq} - \varepsilon_{iq})$. Therefore, the aim of this choice model is to calculate the probability that $V_{iq} - V_{jq}$ will be larger than $(\varepsilon_{jq} - \varepsilon_{iq})$, i.e.,

$$\Pr(x_{iq} | t_q, A) = \Pr_{iq} = \Pr\{[\varepsilon_{jq} - \varepsilon_{iq}] < [V_{iq} - V_{jq}]\} \qquad \forall i,j \text{ with } i \neq j$$

This means that the probability that a consumer will choose the agricultural scenario x_i equals the probability than the difference between the random components of the utility function is smaller than the systematic component of the utility function across the two alternative agricultural practices under consideration. The purpose of the choice model is to estimate the value and statistical significance of the determinants of the utility function. The basic model assumes a linear, additive form of the attributes as specified in (2).

In our questionnaire, the CCE exercise implies a choice between three alternative agricultural scenarios, including the *status quo*. The agricultural scenarios differ with respect to food cost, effects on farmland birds' biodiversity, contamination of soil and aquifers in farmland areas and threats to human health. The utility of alternative *i* for respondent *q* is assumed to depend on:

the food cost of the *q*th respondent related to the *i*th agricultural scenario (x_{fiq});

the effects of the *i*th agricultural scenario on birds' biodiversity for the *q*th respondent (x_{biq});

the contamination of soil and groundwater related to the *i*th agricultural scenario for the *q*th respondent (x_{siq});

the effects of the *i*th agricultural scenario on the health of the general public for the *q*th respondent (x_{hiq}). This leads to the following utility expression:

$$V_{iq} = \beta_{fq} x_{fq} + \beta_{bq} x_{bq} + \beta_{sq} x_{sq} + \beta_{hq} x_{hq} \qquad (6)$$

We assume that the error terms of the resulting utility function are independently and identically distributed and follow the Gumbel distribution. A non-trivial consequence of using this error assumption is the property of independence of irrelevant alternatives (IIA). This property requires that the probability of choosing one alternative over a second one depends only on the utility of the respective alternatives [7]. In other words, the probability ratio of two options should be unaffected by including or omitting other alternatives.

Under this assumption, a conditional logit model results, which predicts the probability of selecting alternative i to be:

$$P_{iq} = \frac{\exp(V_{iq})}{\sum_{j=1}^{J} \exp(V_{jq})} \qquad (7)$$

and:

$$V_{iq} = \sum_{k=1}^{K} \beta_{iq} x_{ikq} \qquad (8)$$

This model is estimated by the method of maximum likelihood.

After estimating the model, we can infer the marginal rate of substitution between any of the attributes in our choice set. The marginal rate of substitution between the food expense coefficient and the biodiversity coefficient gives the implicit WTP to protect farmland bird biodiversity:

$$WTP_b = -(\beta_b / \beta_f) \qquad (9)$$

Similarly, the marginal rate of substitution between the food expense coefficient and the soil contamination one gives the implicit WTP to reduce soil contamination:

$$WTP_s = -(\beta_s / \beta_f) \qquad (10)$$

Finally, the marginal rate of substitution between the food expense coefficient and the human health one gives the implicit WTP to prevent cases of human illness:

$$WTP_h = -(\beta_f / \beta_h) \qquad 11$$

Nevertheless, it is likely that respondents to express their preferences for alternatives by considering reasons beyond the attributes specified.

An alternative-specific constant term, *C*, can be added to the model to capture the effect of some systematic but unobserved factors on the respondents' choices. In other words, while the *x* variables show the effect of deterministic variables in explaining choices (i.e., attributes in the choice sets), the constant *C* captures the unobserved factors that explain choices (see equation 12). Technically, they reflect the mean of the differences in the error terms (Ben-Akiva and Lerman, 1985). In a multinomial logit model it is possible to have (*a*-1) alternative specific constants, where *a* is the number of options. This is because the constants are based on differences between the alternative options and the current situation.

In the present context, though we do not use labelled options, it may be that consumers attach a value to the *status quo* or to one of the two safer agricultural options as such. To test whether this is indeed the case, one can add an alternative specific constant to the utility function:

$$V_{iq} = \delta_{iq} C_{iq} + \sum_{k=1}^{K} \beta_{kiq} x_k \qquad 12$$

More complex specifications are possible which include socioeconomic and attitudinal variables [8].

3.2 THE CONTINGENT VALUATION EXERCISE

In CV surveys, one of the most widely used approaches to elicit information about the respondent's WTP is the so-called dichotomous-choice format (Hanemann 1985, Carson 1985). In the follow-up of our CCE part, we use this type of elicitation question for the respondents' WTP for eliminating all risks, both to human health and the environment, associated with pesticide applications in agriculture. The dichotomous-choice format mimics behaviour in regular markets, where people usually buy, or decline to buy, a certain good at the proposed retail price. Besides, similarly to the CCE technique, this CV format is consistent with the incentive comparability property and is also credited with reducing the cognitive burden placed on the respondent, except that its incentive comparability property might be affected by the previous conjoint questions.

The dichotomous-choice "double-bounded" payment question asked the respondent if he/she would be willing to pay B_1 percent extra on household monthly food expense to gain the proposed improvement in agricultural safety. In a follow-up question respondents who answered "yes" to the first bid value were asked if they would pay B_2^+ percent extra on household monthly food expense, with $B_2^+ > B_1$, while respondents who answered "no" were faced with a B_2^- amount, with $B_2^- < B_1$. The bid value B_1 varied randomly across respondents and the amount of the second bid B_2 depends on the amount of the first one [9].

Four response sequences were possible in our exercise: both answers are positive (yes/yes); both answers are negative (no/no); refuse the first bid but accept the second (no/yes); or accept the first but refuse the second (yes/no). Therefore, for any given underlying WTP distribution $F(B_i;\theta)$, the probability of response is given by:

$$\Pr\{yes/yes\} \equiv P^{yy} = 1 - F(B_2^+;\theta) \qquad (13)$$

$$\Pr\{no/no\} \equiv P^{nn} = 1 - F(B_2^-;\theta) \qquad (14)$$

$$\Pr\{yes/no\} \equiv P^{yn} = F(B_2^+;\theta) - F(B_1;\theta) \qquad (15)$$

$$\Pr\{no/yes\} \equiv P^{ny} = F(B_1;\theta) - F(B_2^-;\theta) \qquad (16)$$

Given these expressions, the log-likelihood function for the double-bounded model can be written as:

$$\log L = \sum_{i=1}^{n} \left[I_{yy} \log P_i^{yy} + I_{yn} \log P_i^{yn} + I_{ny} \log P_i^{ny} + I_{nn} \log P_i^{nn} \right] \qquad (17)$$

Since the follow-up bid amount is greater (lower) than the first for those who answer "yes" ("no") to the initial payment question, the four pairs above identify intervals in which the respondents' WTP amount is assume to fall. Specifically, the respondent's WTP is greater than B_2 for (yes/yes) sequences; WTP falls between B_2 and B_1 for (no/yes) pairs; it falls between B_1 and B_2 for (yes/no); and it is lower than B_2 for (no/no). This yields the following log-likelihood function:

$$\log L = \sum_{i=1}^{n} \log\left[F(WTP^{H};\theta) - F(WTP^{L};\theta)\right] \qquad (18)$$

where WTP^H and WTP^L are the higher and the lower bound of the interval around *WTP* as explained above [10]. Our results are based on the assumption that WTP follows a Weibull distribution.

4. Survey valuation results

4.1 DESCRIPTION OF THE DATA

Table 1 reports descriptive statistics for our sample and compares them with those for the population of Milan, showing that the socio-demographic of our sample are for some part different to those of the population of Milan. The average respondent is 34 years old, has a household income of roughly € 25,000 a year, and has completed high school. The sample is slightly unbalanced toward females, and overrepresents households that large relative to the Milan average. Fifteen percent of the sample has at least one person in the household who is younger than 15.

The main differences between the socio-demographics of our sample and those of the population of Milan concern age and income level. The average age of our sample is rather low -34 rather than 44 years old- and the household income is the 25 percent higher than the Milan average. This suggests that we should control for these individual characteristics in our statistical model of the choice responses. Moreover, twenty-six percent of the respondents have a strong environmental attitude and the 12.2 percent is very well concerned about pesticide risks.

Based on the responses to the choice question and to control questions, we believe that respondent had a reasonably good comprehension of survey material and choice tasks, as only 4.4 percent complained about insufficient information, and 8.5 percent reported that they had found some of the question difficult to understand.

4.2 RESULTS OF THE CONJOINT CHOICE EXPERIMENT

In this paper, we report the results of conditional logit models estimated from the data collected during the Milan survey. As shown in Table 3 we first estimate a basic model and, subsequently, we use interactions between the choice attributes and socio-demographic variables to control for individual characteristics.

All of our models include alternative-B and C-specific intercepts and are weighted with population weights to balance the sample age distribution according to distribution of age in Milan.

The attribute FOODEXP is the cost of the alternatives to the respondent and is expressed as Euros per household per month. BIODIV takes on the values 15, 9, 6 and 3, representing the number of endangered bird species in the alternative scenario. The attribute GRWATER is the percentage of contaminated farmland and can assume values 65, 45, 25, 15. HEALTH takes on the value of 250, 150, 100 and 50, representing the number of cases of acute human intoxication per year due to pesticides.

To capture variation in the marginal utility of the attributes across individuals, one would like to control for the respondent's socio-demographic characteristics. Regarding the preferences for the environmental attributes (biodiversity, soil and ground water protection, human health) one would expect them to vary across respondents' profiles, depending on individual environmental attitude and socio-demographic characteristics. We attempt to control for socio-demographic by creating interactions of the environmental attributes with various socio-demographic characteristics, such as gender, age, education level and whether there are persons under 15 in the respondent's household. A similar logic was applied to respondents' environmental attitude, for which we tried several interactions with attitudinal individual specific variables. Results presented in Table 3 include models with simple interaction with a dummy on respondent's pesticide risk concern.

An important prediction of economic theory is that WTP is an increasing function in the individuals' income level. To capture preferences variation regarding respondents' income level we try an interaction of the FOODEXP variable with the respondents' income level variable.

We begin with a model that include interactions between choice attributes and selected respondents' features, focusing in particular on the effect of respondents' gender, education level, concern on pesticide risks, whether there are person under 15 in the household and income level, on their preferences for reduction of pesticide risks. Results for these conditional logit models are reported in Table 3. All attributes coefficients have the expected *a priori* sign and are highly statistically significant, with the exception of BIODIV. The explanatory power of the models is relatively high for a discrete choice model, with an R-square higher than 0.2 [11].

The coefficient for GRWATER is negative and is strongly statistically significant with a coefficient of -0.017, implying that, all else the same, reducing ground water contamination by 50%, raises the probability of selecting the agricultural scenario by about 2%. The level of impact on human health has a highly statistically significant coefficient equal to -0.0034, while the intensity of impact on bird biodiversity is significant at the 10 percent level with coefficient equal to -0.0319. These results indicate respondents are willing to accept higher food prices to obtain improvements in the agricultural production safety.

Results of the conditional logit model based on our full set of regressors (interactions with attributes) are reported in column (B) and (C). The likelihood ratio (LR) statistics for significant of all coefficients on the interactions between attributes and individual characteristics, which are equal to 9.51, 15.51 and 15.57, respectively, confirm that the choices do depend on certain individual characteristics. The probability of selecting one scenario out of the three alternative options, therefore, depends on the attribute of the agricultural scenarios and respondents' profile in predictable ways.

Column (A) shows that running the model with interactions between attributes and respondents' socio-demographic produces an insignificant and lower coefficient for the BIODIV attribute, and a slightly higher coefficient -though always strongly significant- for the FOODEXP variable (from 0.0008 to 0.0014). Consistently with what predicted by the economic theory, interaction between FOODEXP and income level produces a positive and statistically significant coefficient, even though rather low (0.19^{-04}). The interaction between BIODIV and education level and HEALTH and gender are statistically significant at the 10% level, while the interaction between BIODIV and concern level and GRWATER and the dummy for household with persons under 15 are insignificant. The interaction between GRWATER and the dummy for household with persons under 15 has, in contrast with our expectations, a negative (though insignificant) coefficient.

In column (B), we include an interaction between GRWATER and age, BIODIV and gender, as well as an interaction between HEALTH and pesticide risk concern level. These specifications do not change the coefficient of the choice attributes, which remain stable, but produces a significant (10% level) and positive coefficient for the interaction between GRWATER and the dummy for household with persons under 15. The coefficients on the other regressors are also consistent with our a priori pattern of expectations, though not always statistically significant. Finally, column (C) shows that adding an interaction between HEALTH and the dummy for household with persons under 15 does not change previous results and shows a positive but not significant coefficient, as expected.

Table 3 shows that Milan's respondents are on average willing to pay 24 Euros per household per month to avoid the loss of one species of farmland bird biodiversity, 15 Euros per household per month to avoid the contamination of one percent of farmland soil and aquifer, and 3 Euros per household per month to prevent one case per year of human ill-health. Willingness to pay is, therefore, substantially larger for environmental dimensions than for human health. Nevertheless, it is not possible to make direct comparisons across different pesticide risks and the related WTPs, since the unit of measurement used to quantify risks in the experimental design varies. A more rigorous way of making direct comparisons is to observe unit trade-offs across choice attributes (see

Table 4). From this simple exercise we can see that, on average, respondents are only willing to tolerate about 9 cases of human illness to save an entire species of farmland birds, and 5 cases of human intoxication to reduce soil and ground water contamination with 1 percent. Trade-offs between biodiversity protection and ground water quality show that the respondents were willing to accept only about 2 percent of soil and aquifer contamination to save an entire farmland bird's species. This indicates the importance that the sample attached to both the preservation of human health and the protection of farmland soil and ground water resources. Clearly, the issue of farmland biodiversity decrease is still weakly perceived by Italian households.

Table 3: Conditional logit model results. *T* statistics in parentheses. *N* = 4074.

Variable	*(A) Full model weighted*	*(B) Full model weighted*	*(C) Full model weighted*
Intercept option B [c,d]	1.9220 (16.320)	1.9352 (16.227)	1.9356 (16.200)
Intercept option C[c,d]	1.551 (13.201)	1.5653 (13.124)	1.5676 (13.098)
FOODEXP[c,d]	-0.0014 (-5.308)	-0.0014 (-5.413)	-0.0014 (-5.412)
BIODIV[c,d]	-0.0319 (-1.066)	-0.0341 (-1.114)	-0.0344 (-1.123)
GRWATER[c,d]	-0.0170 (-5.831)	-0.0227 (-5.174)	-0.0227 (-5.181)
HEALTH[c,d]	-0.0034 (-3.385)	-0.0043 (-2.483)	-0.0044 (-2.480)
FOODEXP x income	0.1884(10^{-6}) (2.592)	0.1992(10^{-6}) (2.712)	0.2002(10^{-6}) (2.721)
BIODIV x female	--	-0.0035 (-1.979)	-0.0032 (-1.552)
BIODIV x education level	-0.0085 (-1.060)	-0.0071 (-0.867)	-0.0070 (-0.859)
BIODIV x pesticide risk concern	0.00022 (0.531)	0.2245(10^{-4}) (0.032)	0.0012(10^{-5}) (0.006)
GRWATER x household with person under 15 dummy	-0.00066 (-0.982)	0.0017 (1.192)	0.0012 (0.507)
GRWATER x age	--	0.0001 (1.561)	0.0011 (1.582)
HEALTH x female	0.00071 (1.120)	0.0015 (1.823)	0.0014 (1.775)
HEALTH x dummy for household with person under 15	--	--	0.0023 (0.249)
HEALTH x pesticide risk concern	--	0.0001 (0.289)	0.0001 (0.319)
Log-likelihood	-2036.134	-2033.130	-2033.099
N° of observations	4074	4074	4074
Pseudo-$R^{2(e)}$	0.2150	0.2156	0.2160
LR test of significance of all coefficient	9.51 ($p < 0.01$)	15.51 ($p < 0.01$)	15.57 ($p < 0.005$)

Variable	*(A) Full model weighted*	*(B) Full model weighted*	*(C) Full model weighted*
WTP to protect birds' biodiversity(f)	23.01	24.36	24.57
WTP to reduce soil and aquifer contamination(f)	12.28	16.21	16.21
WTP to protect human health(f)	2.50	3.07	3.14

Table 4: Unit trade-offs across choice attributes.

	Human health	*Soil and groundwater*	*Birds biodiversity*
Human health	1	0.2	0.1
Soil and groundwater	5	1	0.5
Birds biodiversity	9.4	1.8	1

4.3 RESULTS OF THE CONTINGENT VALUATION EXPERIMENT

After having responded to the series of choice modelling questions, respondents were exposed to a CV question with a dichotomous choice double-bounded format (see above). Respondents were asked to indicate whether they would have be willing to accept an increase in their household food expense to eliminate all risks related to pesticide use in agricultural production, i.e. related to both human health and the environment. This exercise allows us to calculate an "overall" WTP estimate for reducing all pesticides negative side-effects, compared to a "target specific" WTP to be inferred by means of the CM questions. What we estimate, using a dichotomous choice format, is the mean WTP for an overall increase in agricultural safety. The density functions of the WTP with a Weibull distribution are plotted in Figure 2. The mean and median WTP estimates appeared to be, respectively, a 19.78 and 15.01 percent increase in the household food expense (see Table 5).

Table 5- Contingent Valuation WTP estimate

WTP(a)	
Mean	19.797
Median	15.009
Lower bound	14.544
Upper bound	15.475

Notes:

(a) WTP are measured as percentage of increase in the household food expense

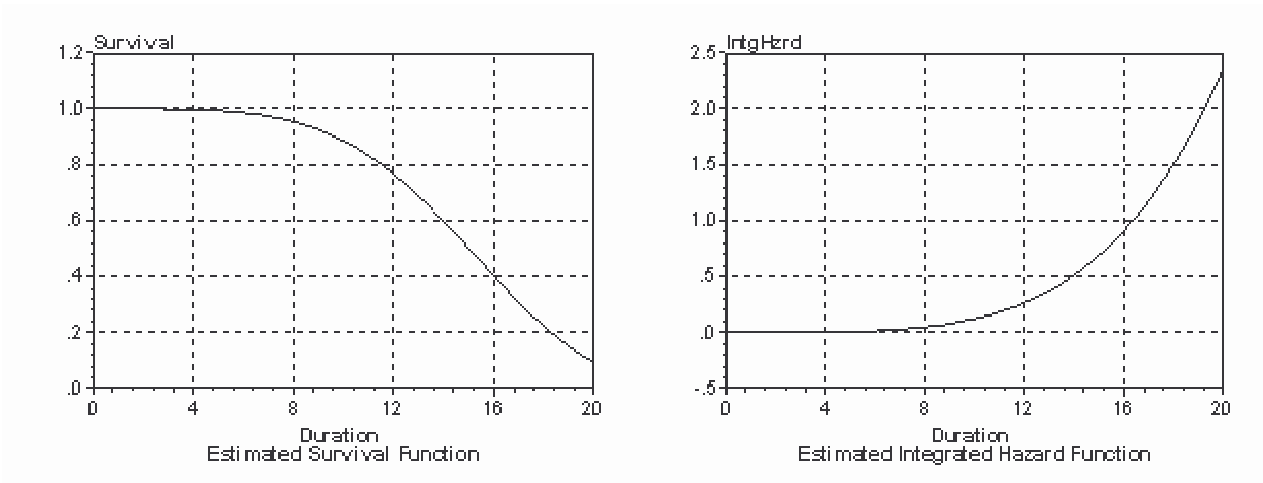

Figure 2 - Density and hazard function of WTP inferred from the CV question

5. Discussion and Conclusions

This study presents the results of a stated choice approach combining choice experiment and contingent valuation techniques to isolate the willingness to pay for improvements in agricultural safety for human health and environmental concerns, namely farmland biodiversity, soil and ground water. A rather more interesting part appears to be the choice experiment in which we use a "green" food expense payment package to elicit the respondents' preferences for alternative agri-environmental scenarios, proposing them a series of four or five choice sets made up of three possible options of agricultural practices, including the *status quo*. The biggest advantage of this methodology in respect to contingent valuation is that respondents were forced to make trade-offs - not only between environmental issues and money- but also among different aspects of environmental safety. These are important and typical features of environmental decision-making and, therefore, it is easy to appreciate the merits of these kinds of results.

From a statistical point of view, the results of the choice modelling experiment perform well in terms of theoretical validity. Our *a priori* expectation on the effect of differences in the respondents' socio-economic profile on attribute coefficients is confirmed by the statistical analysis, with the exception of the effect of gender and education level. This suggests that some degree of bias, probably related to the sampling process might be present to be investigated in a following experiment.

Our conditional logit models of the choice responses indicate that the choice between agricultural scenarios *does* depend in predictable ways on the attributes. For example, respondents consider the food shopping less attractive if the groundwater pollution generated from the food production process is increased. As well, respondents are against cheaper shopping that, on the other hand, have heavier effects on biodiversity and human health. A first result is, therefore, that respondents are capable of assessing agricultural scenarios defined by multiple attributes. Second, respondents do assess agricultural scenarios described in terms of environmental and monetary attributes as we expected, showing a positive willingness-to-pay for a gain in agricultural environmental safety.

We examine also the effects of respondents' attitudinal and socio-demographic characteristic on their preferences, via interactions between choice attributes and explanatory variables, with a special focus on: gender, age, education level, income level, pesticide risk concern and whether in the household there are persons under 15.

Our a priori pattern of expectations is satisfied with the exception of the interaction between BIODIV and gender and BIODIV and the respondent's education level, which show negative coefficients (Table 3, column (C) and (D) (see also Hammitt, 1990). Women are less prone to pay for bird's biodiversity than men, while they are more prone to pay for human health than men are. While previous studies on individual preferences for pesticide related issues (Govindasamy *et al.*, 1998a, 1998b, Foster and Mourato, 2000) show that women usually exhibit a more altruistic attitude than men, our results seem to indicate that actually women are more willing to pay for enhancing agricultural safety for themselves and the general public, while are less willing to pay for protecting biodiversity than men. To some extent our study shows that female respondents do assign a higher priority to Italians' safety than men do.

Using a five-point Likert scale, respondents were asked to declare their level of concern on the topic proposed in the questionnaire choosing between a *not at all informed* and a *very well informed* position. The interactions between both BIODIV and HEALTH with the pesticide risk concern variable have a positive coefficient in all our models. This means that the higher the respondent's concern on the topic of our questionnaire, the higher the WTP for human health and for birds' biodiversity.

Importantly, consistently with what predicted by the economic theory, interaction between FOODEXP and income level produces a positive and statistically significant coefficient in all our models, even though the elasticity is rather low (0.19^{-04}).

In addition, the survey shows that Milan's respondents are on average willing to pay 24 Euros per household per month to avoid the loss of one species of farmland bird biodiversity, 15 Euros per household per month to avoid the contamination of one percent of farmland soil and aquifer, and 3 Euros per household per month to prevent one case per year of human ill-health. Though one might be surprised by the fact that biodiversity and groundwater got a higher value compared to human health, a comparison of unit trade-offs reveals that Milan's respondents perceive strongly the possible risks for human health related to pesticides use, while there is much less concern about the rather vague concept of biodiversity.

6. References

Adamowicz, W., Louviere, J.J., Williams, M. (1994). "Combining Revealed and Stated Preference Mehtods for Valuing Environmental Amenities", *Journal of Environmental Economics and Management*, 26:271-292.

Adamowicz, W., Swait, J., Boxall, P., Louviere, J.J., Williams, M. (1996). "Perceptions versus Objective Measurement of Environmental Valuation", *Journal of Environmental Economics and Management*, 32: 65-84.

Armstrong P., Garrido, R., Ortùzar (2001). Confidence intervals to bound the value of time. *Transportation Research, Part E* 37(2-3): 143-161.

Baker, G. (1999). "Consumer preferences for food safety attributes in fresh apples: market segments, consumer characteristics and marketing opportunities." *Journal of Agricultural and Resource Economics*, 24(1): 80-97.

Baker, G.A.C., Crosbie, P.J. (1993). "Measuring food safety preferences: identifying consumers segments." *Journal of Agricultural and Resource Economics*, 18: 277-287.

Ben-Akiva, M., Lerman, S.R. (1986). *Discrete Choice Analisi: Theory and Application to Travel Demand*, The MIT Press, Cambridge.

Blamey, R.K., Common, M.S., Quiggin, J. (1995). "Respondents to Contingent Valuation Surveys: Consumers or Citizens?", *Australian Journal of Agricultural Economics*, 39(3):263-288.

Brethour, C. A., Weersink, A. (2001). "An Economic evaluation of the environmental benefits from pesticide reduction." *Agricultural Economics*, 25: 219-226.

Bunch, D.S., Louviere, J.J., Anderson, D. (1993). A Comparison of Experimental Design Strategies for Multinomial Logit Models: The Case of Generic Attributes. Working Paper.

Buzby J.C., Ready R.C., Skees, J.R. (1995). "Contingent Valuation in Food Policy Analysis: A Case Study of a Pesticide Residue Risk Reduction", *Journal of Agricultural and Applied Economics*, 27(2): 613-625.

Cuyno, L. C. M., Norton, G. W., Rola A. (2001). "Economic analysis of environmental benefits of integrated pest management: a Philippine case study." *Agricultural Economics*, 25: 227-233.

Diamond, P.A., Hausman, J.A. (1994). "Contingent Valuation: Is Some Number Better than Non Number?", *Journal of Economics Perspectives*, 8(4): 45-64.

Eom, Y. S. (1994). "Pesticide Residue Risk and food Safety Valuation: A Random Utility Approach." *American Journal of Agricultural Economics*, 76: 760-771.

Foster V., Mourato, S. (2000). "Valuing the Multiple Impacts of Pesticides Use in the UK: A Contingent Ranking Approach." *Journal of Agricultural Economics*, 51: 1-21.

Fu T-T, Liu J-T, Hammitt, J.K. (1999). "Consumer willingness to pay for low-pesticide fresh produce in Taiwan", *Journal of Agricultural Economics*, 50(2): 220-233.

Govindasamy, R., Italia, J., Rabin, J. (1998b). Predicting Consumer Risk Aversion to Synthetic Pesticide Residues: A Logistic Analysis. New Brunswick, Department of Agricultural Economics, The State University of New Jersey, Rutgers.

Govindasamy, R., Italia, J., Rabin, J.. (1998a). Consumer response and perceptions of integrated pest managenet produce. New Brunswick, Department of Agricultural Economics, The State University of New Jersey, Rutgers.

Green, W.H. (2002). *Econometric Annalysis*, 4th edition. Pretice Hall, Upper Saddle River, NY.

Hammitt, J. K. (1990). "Risk Perceptions and Food Choice: An Exploraty Analysis of Organic-Versus Conventional - Produce Buyers", *Risk Analysis*, 10: 367-374.

Hensher, D. A., Jonhnson, L. W. (1981). *Applied Discrete Choice Modelling*. John Wiley and Sons, New York.

Higley, L. G., Wintersteen, W.K. (1992). "A novel approach to environmental risk assessment of pesticides as a basis for incorporating environmental costs into economic injury level." *American Entomologist*, 38: 34-39.

Lancaster, K. (1966). "A new approach to consumer theory", *Journal of Political Economy*, 74: 132-157.

Lazari, A.G., Anderson, D.A. (1994). "Design of Discrete Choice Set Experiments for Estimating Both Attribute and Availability Cross Effects", *Journal of Marketing Research*, 31: 375-383.

Louvier, J.J., Hensher, D.A. (1982). "On the Design and Analysis od Simulated Choice or Alocation Experiments in Travel Choice Modelling", *Transportation Research Record*, 890:11-17.

Louvier, J.J., Woodworth, G. (1983). "Design and Analysis of Simulated Choice or Allocation Experiments: An Approach Based on Aggregate Data", *Journal of Marketing Research*, 20: 350-367.

Louviere J. J., Hensher, D.A., Swait, J.D. (2000). *Stated choice methods; analysis and applications*, Cambridge University Press, Cambridge.

Maler, K.G. (1974). *Environmental Economics: A Theoretical Inquiry*, The Johns Hopkins University Press, Baltimore.

McFadden, D. (1986). "The Choice Theory Approach to Market Research", *Marketing Science*, 5: 275-297.

McFadden, D. (1994). "Contingent Valuation and Social Choice", *American Journal of Agricultural Economics*, 76: 689-708.

McFadden, D. Train, K., Tye, W.B. (1977). "An Application of Diangostinc Tests for the Independence from Irrelevant Alternatives Property of the Multinomial Logit Model", *Transportation Research Record*, 637: 39-45.

Misra, S.K., Huang, C.L., Ott, S.L. (1991). "Consumer Willingness to Pay for Pesticide-Free Fresh Produce", *Western Journal of Agricultural Economics*, 16: 218-227.

Mitchell, R. and Carson, R. (1989). *Using Surveys to Value Public Goods: The Contingent Valuation Method*, Resources for the Future, John Hopkins Press, Baltimore.

Morrison, M.D., Bennett, J.W. (1997). *Water Use Trade-offs in the Macquarie and Gwydir Valleys*. Choice Modelling Research Report No.2, School of Economics and Management, University College, The University of New South Wales.

Mourato, S., Ozdemiroglu, E., Foster, V. (2000). "Evaluating health and environmental impacts of pesticide use: implications for the design of ecolabels and taxes", *Environmental Science & Technology*, 34(8), 1456-1461.

Mullen J.D., Norton G.W., Reaves, D.W. (1997). "Economic Analysis of Environmental benefits of Integrated Pest Management", *Journal of Agricultural and Applied Economics*, 29(2): 243-253.

Opaluch, J.J., Swallow, S.K., Weaver, T., Wessells, W. Wichelns, D. (1993). "Evaluating Impacts from Noxious Facilities: Including Public Preferences in Current Siting Mechanisms", *Journal of Environmental Economics and Management*, 24: 41-59.

Pimentel, D., Acquay, H., Biltonen, M., Rice, P., Silve, M., Nelson, J., Lipner, V., Giordano, S., Horowitz, A., D'amore, M. (1992). Environmental and human costs of pesticide use. *Bioscience* 42: 750-760.

Pimentel, D., Greiner, A. (1997). Environmental and socio-economic costs of pesticide use. In Pimentel, D. (eds), *Techniques for reducing pesticide use: economics and environmental benefits*. Chinchester: John Wiley and Sons, 51-78.

Press J., S., SÖderqvist, T. (1998). On estimating the benefits of groundwater protection: a contingent valuation study in Milan. In Swanson T., Vighi M. (Eds), *Regulating Chemical Accumulation in the Environment*, Cambridge University Press, Cambridge.

Ravenswaay van , E.O., Hoehn, J.P. (1991). Contingent Valuation and Food Safety: the case of pesticides residues. Dept. of Agricultural Economics, Staff Paper N. 91-13. East Lansing, MI: Michigan State University.

Rizzi, L. I., Ortùzar, J. D. (2003). Stated preferences in the valuation of interurban road safety. *Accident Analysis and*

Prevention 25(1): 9-22.

Schou, J. S., Hasler, B., Kaltoft, P. (2002). "Valuing biodiversity effects of pesticide use. What does perception of uncertainty mean for survey design?", Conference Proceedings. Risk and Uncertainty in Environmental and Resource Economics, Wageningen, The Netherlands.

Stevens, T. H., Echevarria, J., Glass, R. J., Hager, T. and More, T. A. (1991). Measuring the Existence Value of Wildlife: What Do CVM Estimates Really Show?, *Land Economics*, 67(4), 390-400.

Vestein, K., Hoen, H., Navriud, S.and Strand, S. (1993). Valuing Biodiversity in Norwegian Forests: A Contingent Valuation Study with Multiple Bias Testing. Memorandum No. /, Department of Economics, University of Oslo.

STOA (1998). http://www.europarl.eu.int/stoa/publi/98-11-01/chap1_en.htm

8. NOTES

1. Italy has the third highest level of pesticide consumption with the 13 percent of total purchases, and a rate of consumption of about 7.7 kg of pesticide per hectare of agricultural land treated (OECD, 1991).
2. A pre-test on 40 respondents was undertaken in April 2003 in Milan.
3. A draft version of the questionnaire asked respondents to choose among a conventional package of spaghetti and spaghetti produced with wheat from more environmentally benign agricultural practices. The pilot survey showed that respondents were disturbed by a “single-green produce” perspective, being more comfortable with choices related to the whole shopping basket for foodstuff (a “green food expense” payment portfolio).
4. University campuses and shopping centers were considered to be privileged locations to maximize the visibility of our questionnaire and the sampling size, curbing the generally high costs of surveys. In university campuses interviewers asked people to pick up the questionnaire, bring it home and make it compiled by the member of the family responsible for the daily food shopping. In shopping centers, people were asked to pick up the questionnaire before shopping, compile it and drop it off to the interviewer after shopping.
5. The attribute levels used in the choice sets were: monthly food expense (actual; +50€; +100€; +200€); number of endangered bird species (15, 9, 3); % of farmland contaminated (65, 45, 15); cases of acute pesticide intoxication per year (250; 100; 50).
6. The design of the 9 choice sets is consistent with modern principles of experimental design (Bunch et al., 1993; Lazari and Anderson, 1994). In particular, we used a shifted or cyclic design, which generally has a superior efficiency compared to other strategies for generating main effects designs (Bunch et al., 1993). These shifted designs use an orthogonal fractional factorial to provide the basic alternatives for each choice set. Subsequently, the alternatives within a choice set are cyclically generated. The attribute levels of the new alternatives add one to the general level of the previous alternative, until it is at its maximum. At this point, the assignment returns to the lowest level. We started, therefore, from a set of 81 possible permutations of the hypothetical agricultural scenario (3 levels4 attributes). Then, we generated the ‘fractional factorial’ using a simple routine in the software package SPSS®. Subsequently, we used a cyclic designed to generate 9 choice sets. These choice sets satisfy the principle of orthogonality, level balance, and minimal overlap (see Huber and Zwerina, 1996).
7. Violation of the IIA assumption may occur for various reasons, such as the inclusion of close substitutes in choice sets or the existence of random taste variations, i.e. heterogeneous preferences. Various tests have been proposed for detecting violations of the assumption of identically and independently distributed error terms, including the estimation of a mother logit (McFadden et al., 1977; McFadden, 1986). If an IIA violation is found, it may be possible to modify the existing MNL model to remove the violation, for instance by including individual characteristics in the model, or by estimating more complex models that relax part or all of the IIA assumption.
8. It is not possible to include socioeconomic and attitudinal variables directly into utility functions, as these are invariant across the alternatives in a choice set. Hence, their coefficient cannot be estimated. Instead, they have to be estimated interactively, either with the alternative-specific constant (C), or with one of the attributes from a choice set (X) (see Swallow et al. 1994):

   $$V_i = C + \sum_h CS_h + \sum_k \beta_k X_k + \sum_{h,k} \beta_k S_h X_k$$

   where i=1,....N; k=1,...,K; h=1,..., H; C is an alternative-specific constant, β is a coefficient, X is a variable representing an attribute from a choice set, and S represents socioeconomic or attitudinal variables.
9. Three different initial bid values B, randomly distributed among respondents, were used in our survey: plus 10 percent; plus 15 percent, plus 20 percent of the monthly household food expense. Those respondents who accepted the first bid were then faced with increments of, respectively, 20 percent, 30 percent and 40 percent; while respondents answering “no” where faced with increments of, respectively, 5 percent, 10 percent and 10 percent.
10. One should bear in mind that for respondents who give two positive responses, the upper bound of WTP might be infinity, +∞ (or the respondent’s income); while for those who give two negative answers, the lower bound is either zero (if the distribution of WTP admits only positive values) or negative infinity, -∞, if the WTP distribution is a normal or a logistic one.
11. Hensher and Johnson (1981) comment that “the value of R-square between 0.2 and 0.4 are considered extremely good fits, so that the analysis should not be looking for values in excess of 0.9, as it is often the case for when using R2 in ordinary regression”.
12. Coefficients across all segments of the population are implicitly restricted to be equal to $\log_{LR}$, while coefficients of

sub-models are allowed to vary ($\Sigma Mlog_{LM}$). The test statistics is $2[(\Sigma Mlog_{LM})-log_{LR}]$ and is distributed as a chi-squared variable with degrees of freedom equal to ($dof_{LR}-dof_{LM}$).

13. The critical value for a chi-squared distribution with one degree of freedom (3.841) is considered for sub-models based on: sex, motherhood, education, attitude and concern. For sub-models based on income level we consider the critical value for a chi-squared distribution with three degrees of freedom (7.815).
14. Respondents can show a lexicographic behaviour even when unlabelled options are used. Rizzi and Ortùzar (2003) identify three main reasons for lexicographic response patterns. One is related to a weak experimental design in which the differences in the attribute levels are simply not large enough to enable respondents to trade-off the choice attributes. A second reason could be simplification. If the cognitive effort required to answer is excessive for the respondent, he or she might choose the option that is the best in terms of just one attribute. Finally, lexicographic answers might come from respondents with random response patterns.